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PRELIMINARY RESULTS FROM CYCLE IV OF THE GERM PLASM EVALUATION PROGRAM AT THE ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER

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Breed differences in performance characteristics are an important genetic resource for improving efficiency of beef production. Diverse breeds are required to exploit heterosis and complementarity through crossbreeding and to match genetic potential with diverse markets, feed resources and climates. This report presents preliminary results from an ongoing study at the Roman L. Hruska U.S. Meat Animal Research Center to characterize breeds of cattle representing different biological types for traits that influence quantity and value of production.

Experimental Procedure

The Germ Plasm Evaluation (GPE) program has been conducted in four cycles. Table 1 shows the mating plan for cycles I, II, III, and IV. Each cycle was initiated by mating Hereford and Angus cows by artificial insemination (AI) to sires of diverse breeds. Semen from the same Hereford and Angus bulls has been used throughout to produce control Hereford-Angus (original HAx, sires born 1968-70) reciprocal crosses in each cycle. In cycle IV, new samples of Hereford and Angus (current HAx, sires born 1982-84) bulls were added to evaluate genetic trends within these breeds. In cycle IV, semen from 14 original control Angus, 11 original control Hereford, 30 current Angus, 32 current Hereford (14 horned and 18 polled), 29 Longhorn, 24 Piedmontese, 31 Charolais, 29 Salers, 31 Galloway, 22 Nellore, and 26 Shorthorn bulls is being used by AI to produce about 200 calves per sire breed in five calf crops (1986-1990). Following an AI period of about 45 days, one or two bulls each of Angus, Hereford, Charolais, Gelbvieh, and Pinzgauer bulls are used each year by natural service in single-sire breeding pastures for about 21 days. These breeds are being used in clean-up matings to increase ties to previous cycles and facilitate eventual pooling of results over all four cycles.

Calving occurs in the spring, beginning in late March and ending in mid-May. Calves are weighed, tattooed, and tagged for identification. Male calves are castrated within 24 hours of birth. Calves are creep fed whole oats from mid-July until weaning in early October.

Following a postweaning adjustment period of about 35 days, steers are penned and fed separately by sire breed for about 200 to 263 days. Growing diets contain 66% corn silage, 22% corn, 12% supplement and the finishing diet fed from about 700 lb to slaughter contains 25% corn silage, 70% corn, 5% supplement. Representative samples of steers are slaughtered serially in 4 slaughter groups spanning at least 63 days. The steers are slaughtered in a commercial packing plant, and hot carcass weights are obtained and used to estimate dressing percent (100 X carcass weight/final live weight). After a 24-hour chill, USDA yield grade (fat thickness, longissimus area, estimated % kidney fat) and quality grade (marbling, maturity) data are obtained. The right side of the carcass is transferred to the meat laboratory at MARC and

fabricated into boneless, retail cuts trimmed to 8 mm fat thickness. Retail cuts are then trimmed free of fat (0 mm) and reweighed. Retail product (including all steaks, roasts and lean trim (trimmed to 25% fat basis)) from the right side is doubled to estimate retail product yield from the carcass in terms of weight and as a percentage of cold carcass weight. Warner-Bratzler shear determinations of tenderness are taken on cooked rib steaks from each carcass following AMSA procedures.

All F1 females produced are retained to evaluate growth, age at puberty, reproduction and maternal performance through mature ages. Heifers are carried in a drylot from weaning to about 400 days of age on a diet containing 54% corn silage, 42% haylage, 4% supplement until January and 45% corn silage, 54% haylage and 1.1% supplement until they are moved to grass in the spring. Estrus was checked visually twice daily from an average age of about 250 days until the end of the breeding season at about 450 days of age. Date at puberty was defined at date at first observed estrus confirmed by a subsequent estrus observed within 45 days. Females are bred by natural service to Red Poll sires to produce their first calves as 2-year-olds and subsequently to Simmental sires through mature ages. Preweaning management is the same as that described above for F1 crosses, except that progeny of F1 dams are not creep fed.

TABLE 1. SIRE BREEDS USED IN GERM PLASM EVALUATION PROGRAM

Cycle I (1970-72)	Cycle II (1973-74)	Cycle III (1975-76)	Cycle IV (1986-90)
F1 crosses from Hereford or Angus dams (Phase 2)			
Hereford	Hereford	Hereford	Hereford[a]
Angus	Angus	Angus	Angus[a]
Jersey	Red Poll	Brahman	Longhorn
South Devon	Brown Swiss	Sahiwal	Salers
Limousin	Gelbvieh	Pinzgauer	Galloway
Simmental	Maine Anjou	Tarentaise	Nellore
Charolais	Chianina		Shorthorn
			Piedmontese
			Charolais
			Gelbvieh
			Pinzgauer
3-way crosses out of F1 dams (Phase 3)			
Hereford	Hereford		
Angus	Angus		
Brahman	Brangus		
Devon	Santa Gertrudis		
Holstein			

[a]Hereford and Angus sires, originally sampled in 1969, 1970 and 1971, have been used throughout the program. In Cycle IV, a new sample of Hereford and Angus sires produced after 1982 are being used and compared to the original Hereford and Angus sires.

Preliminary Results

Breed group means averaged over Hereford and Angus dams are shown in Table 2 for calving difficulty, birth weight, calf survival, and 200-day weight. These results are preliminary, including the first four of five calf crops to be produced in cycle IV. F1 progeny by current Hereford and Angus sires were heavier at birth (5.5 lb) and weaning (18 lb) than F1 progeny by original Hereford and Angus sires, indicating that significant genetic change for growth rate accrued in these breeds between the late 1960's and the early 1980's in response to selection emphasis that seedstock breeders for both of these breeds. It might be surprising to readers that the increase in birth weight for progeny of current versus original sires was associated with only a slight increase in calving difficulty; however, the Hereford and Angus cows producing these calves were 3 through 10 years of age. Calving difficulty is not expected to be a serious problem in cows these ages.

Relative to original Hereford-Angus crosses, the results for birth weight and 200-day weaning weight of Charolais and Gelbvieh were consistent with those observed in previous cycles. Weaning weights of Longhorns were the lightest. Galloway were similar to Hereford-Angus crosses by original sires in weaning weight. Weaning weights of Shorthorn and Salers crosses were similar to Pinzgauer and intermediate to current Hereford-Angus crosses and the heaviest breed groups, Nellore and Charolais.

Breed group means for final weight and certain carcass and meat characteristics are shown in Table 3 for steers from the first three of five calf crops to be produced. Differences among breeds for final weight correspond relatively closely to those for weaning weight, except that Nellore crosses were relatively lighter after the postweaning period which included the winter months. Progeny of current Hereford and Angus sires were significantly heavier than progeny of original sires; however, carcass composition and marbling was similar. Breed groups that excelled in marbling and percentage grading choice (Shorthorn, Angus-Hereford crosses) had the lowest percentage retail product. Breeds that have the highest yields of retail product (Piedmontese, Charolais, Gelbvieh, Salers and Nellore) had the lowest percentage grading choice.

Carcasses from Galloway and Longhorn crosses had higher percentage retail product, but were lighter in weight and had fewer grading Choice than Hereford-Angus crosses. Piedmontese crosses excelled in carcass composition. Although Piedmontese crosses ranked eighth (comparable to original Hereford-Angus crosses) among the 11 breed groups in final weight, they ranked second in weight of totally trimmed (0 mm) retail product due to exceptional dressing percentage and significantly higher retail product percentages than other breeds. Salers crosses were intermediate in growth rate to weaning and yearling ages. Marbling was low but retail product yield as a percentage of carcass weight was relatively high in Salers crosses. Salers, Pinzgauer, Gelbvieh and Nellore crosses were comparable in lean growth potential as reflected in weight of retail product at 417 days of age.

Breeds ranked very differently for marbling than they did for tenderness. Shorthorn crosses and Hereford-Angus crosses excelled in marbling but shear and sensory panel estimates of tenderness were comparable to those of other Bos taurus sired breed groups with lower levels of marbling. Percentage grading

TABLE 2. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM, CYCLE IV-PHASE 2 CALVES BORN 1986-89

Breed group of calf	No. calves Born	No. calves Wean.	Calvings unassisted %	Birth weight lb	Calf surv. %	200-day weight Units lb	200-day weight Ratio %
Original HAx	167	163	95.3	79.3	96.3	463	96.1
Current HAx	197	181	96.4	85.9	91.6	481	100.0
Charolais	172	155	90.8	90.2	89.9	508	105.5
Gelbvieh	203	191	98.1	89.3	94.0	504	104.8
Pinzgauer	208	197	95.0	89.5	95.0	499	103.7
Shorthorn	134	125	99.6	87.4	93.2	492	102.2
Galloway	147	139	98.2	81.0	94.3	459	95.5
Longhorn	171	158	99.7	71.3	92.8	441	91.6
Nellore	172	160	94.3	89.6	93.0	507	105.4
Piedmontese	174	163	93.7	84.9	93.6	483	100.3
Salers	160	150	97.8	85.4	93.9	495	102.8

TABLE 3. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM CYCLE IV-PHASE 2 STEERS BORN 1986-88[a]

Breed group of steer	No.	Final wt lb	Dress. pct. %	USDA Choice %	WB shear lb	Fat thick-ness in	Rib eye area sq in	Retail product .3 in trim %	Retail product .0 in trim %	Retail product .3 in trim lb	Retail product .0 in trim lb
Orig. HAx	46	1079	62.2	79	11.7	.58	10.90	69.1	63.3	443	406
Cur. HAx	58	1145	62.1	74	12.5	.55	10.88	69.3	63.6	474	434
Charolais	55	1218	62.0	51	12.8	.38	12.27	71.9	66.7	553	484
Gelbvieh	87	1175	62.2	45	12.3	.36	12.10	72.2	67.0	507	469
Pinzgauer	70	1155	61.1	59	11.2	.42	11.29	70.6	65.3	481	444
Shorthorn	53	1172	62.0	89	12.4	.49	11.06	69.0	63.5	483	443
Galloway	46	1045	62.5	63	12.4	.44	11.12	71.8	66.2	450	414
Longhorn	56	976	61.7	62	12.6	.36	10.59	71.6	66.2	415	383
Nellore	61	1121	64.9	47	15.4	.49	11.51	71.3	65.8	499	460
Piedmontese	53	1091	63.9	41	11.0	.29	13.19	75.5	70.9	505	474
Salers	50	1155	62.6	47	13.2	.40	11.79	71.9	66.5	496	459

[a]Means for weight and carcass traits at average slaughter age of 417 days.

Choice was low but steaks were relatively tender in Piedmontese crosses. Marbling was also low in Nellore crosses and their shear values were distinctly higher than all other crosses. Steaks from Nellore crosses, like Bos indicus breeds evaluated earlier (Brahman and Sahiwal), were less tender than those from Bos taurus sire breeds.

Breed group means for 400-day weights, 550-day weights, puberty characteristics and conception rate of heifers are shown in Table 4. Means for calf crop percentage, calving ease, birth and weaning weights of progeny are shown in Table 5. Again, it is emphasized that these results are preliminary, including females from only the first two of five calf crops to be produced in cycle IV. Means for traits such conception rate, percentage calf crop born and weaned, and percentage calvings unassisted have large experimental errors due to their all or none (calf or no calf) nature and the limited number of matings to date (e.g., one calf affects each breed group mean about 1.5 to 2%).

Breed group differences for 400- and 550-day weights in heifers correspond closely to those for final weight in steers. Nellore crosses like Brahman and Sahiwal breeds evaluated earlier, were relatively older at puberty, but excelled in calving ease due to maternal effects reducing birth weight. Birth weights of progeny and calving assistance were relatively low for Longhorn F1 females. Considering the heavy birth weights of progeny, calving assistance tended to be relatively low for Salers and Shorthorn females. Birth weights of progeny of Hereford-Angus cross females by current sires were heavier than those by original sires but calving assistance was similar. Progeny out of Salers, Nellore, Shorthorn, Pinzgauer, and Gelbvieh sired F1 females were heavier at weaning than those out of Piedmontese and current Hereford-Angus crosses which were in turn heavier than those out of original Hereford-Angus crosses or Longhorn and Galloway sired F1 females.

TABLE 4. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM, CYCLE IV-PHASE 2 HEIFERS BORN 1986-87

Breed group of female	No.	400-day weight lb	550-day weight lb	Puberty expressed %	Age at puberty[a] Act. d	Age at puberty[a] Adj. d	Preg. rate %
Original HAx	46	723	840	95	370	373	95
Current HAx	48	766	890	97	365	368	87
Charolais	38	781	923	91	361	367	83
Gelbvieh	58	755	890	98	357	359	83
Pinzgauer	59	779	915	100	357	357	92
Shorthorn	32	778	909	95	363	367	84
Galloway	40	690	807	94	368	373	81
Longhorn	44	661	794	95	375	378	86
Nellore	42	746	891	94	402	407	92
Piedmontese	48	726	862	98	354	355	95
Salers	38	779	917	98	366	368	90

[a]Actual age at puberty for the heifers expressing puberty (ranging from 91 to 100 percent) and adjusted age at puberty, adjusted to remove bias due to differences in percentage expressing puberty by adding i(s) where i is the expected negative deviation from the true mean in standard deviation (s) units.

TABLE 5. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM, CYCLE IV-PHASE 3 CALVES BORN 1988-89[a]

Breed group of dam	No. cows exp.	Calf crop Born %	Calf crop Wean. %	Calvings unassisted %	Birth weight lb	200-day weight Units lb	200-day weight Ratio %
Original HAx	74	89	83	67.6	75.6	458.3	94.0
Current HAx	78	92	89	68.9	80.2	487.5	100.0
Charolais	60	81	76	72.9	83.0	498.7	102.3
Gelbvieh	68	82	79	70.7	78.7	507.7	104.1
Pinzgauer	72	85	81	64.0	82.4	508.1	104.2
Shorthorn	43	90	85	75.2	84.0	512.6	105.1
Galloway	67	83	80	74.9	74.1	449.2	92.1
Longhorn	70	92	89	86.0	74.9	464.2	95.2
Nellore	69	94	93	95.1	70.7	513.5	105.3
Piedmontese	78	90	88	64.6	79.2	491.9	100.9
Salers	58	88	85	85.7	82.5	523.9	107.4

[a]Data are for 560 F1 females exposed to Red Poll bulls to produce first calves at 2 years of age and for 312 F1 females exposed to Simmental bulls to produce their second calves at 3 years of age.